

CURICTAN COPULATION AND WATERSCORPION HIGHER CLASSIFICATION (HETEROPTERA: NEPIDAE)

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Abstract.—The copulatory posture of *Curicta howardi* is described in detail. One aspect of curictan copulation, the grasping of the female's head by the male protibia, is tentatively identified as unique to the genus and therefore diagnostic. We relate our observations and those of previously studied waterscorpions to the currently accepted higher classification of the Nepidae (Lansbury 1974) and conclude that copulatory posture may be of subfamilial significance, thereby lending support to the inclusion of *Curicta* in the subfamily Nepinae. However, copulation has not been studied in two key genera, the Australian endemics *Austronepa* and *Goondnomdanepa*. Both of these genera are currently placed in the subfamily Ranatrinae but also possess certain of the tribal characteristics of *Curicta* and the other Nepinae genera. Thus, if they are found to copulate in a nepine/curictine manner, then copulatory posture as a suprageneric character would contribute to the tribal, rather than the subfamilial, classification of the family.

Key Words: *Curicta howardi* Montandon, waterscorpion copulation, Nepidae higher classification, Heteroptera

Little is known about copulatory behavior in waterscorpions. Thus far, information is available only for *Curicta howardi* Montandon (Wiley 1922, 1924), *Laccotrephes fabricii* Stål (Mattei 1965), *Nepa cinerea* L. (Poisson 1924, Larsén 1938), and *Ranatra linearis* L. (Larsén 1938). This paper presents further information on copulation in *Curicta howardi* and relates our observations to the currently accepted higher classification of the Nepidae (Lansbury 1974).

METHODS AND MATERIALS

In July of 1988, two populations of *C. howardi* were collected from the Coastal Plain region of Texas and returned to the laboratory at Southern Illinois University at Carbondale, Illinois. The first population was taken from Skull Creek, ca. 2 km west

of Altair at Route 90, Colorado County. The second population was collected from San Fernando Creek at Route 44, 1 km east of Alice, Jim Wells County. The specimens were maintained in 5 gallon aquaria with a sloping sand beach at one end and approximately 1 inch of deionized water at the other end. The aquaria were kept in incubators under identical rearing conditions approximating the May-July photoperiod and temperatures in the collection area, i.e. 14L:10D photoperiod and 27.5-28.9°C. Small pieces of plastic aquarium plants were placed in the water to provide a perch for the adults. Aquaria were cleaned weekly or more often if they became fouled. Specimens were fed a variety of foods, primarily Corixidae and small *Bueno* sp. (Notonectidae), approximately 1.5 food items/day.

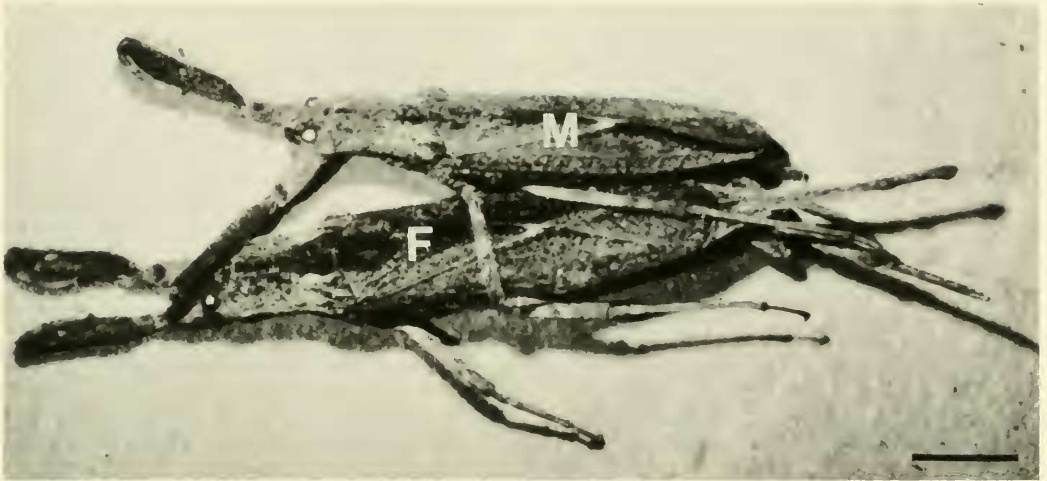


Fig. 1. Male and female *C. howardi* in copula, dorsolateral view (bar scale = 3 mm). M = male; F = female; OP = male operculum.

The aquaria were checked irregularly throughout both the incubator's day and night cycle for copulating pairs which, when discovered, were preserved for study by spraying with ethyl chloride followed by freezer storage. Photographs were taken on Kodak Panatomic-X film with a 35 mm Contax camera adapted to a Zeiss SR Stereo microscope.

RESULTS

Copulation was observed in the laboratory on a daily basis but only during the night cycle of the incubator. Duration of copulation events varied from about 5 minutes to 8 hours. (It is possible that the short copulations were not completed even though the male had assumed the copulatory posture outlined below.) Lengthy copulations were not unexpected because two of the adults used in this study were collected in copula in the field and remained thus for about eight more hours. No apparent courtship behavior was detected prior to copulation.

At the onset of copulation, a male would approach a female, usually from her right side, and grasp her with his three adjacent legs (Fig. 1). In this grasp, his protibia was hooked over her head between the eye and

the adjacent paraclypeus. His mesofemur was thrown over the dorsum of her abdomen posterior to the scutellum, and his mesotibia was flexed ventrally under her abdomen. His metathoracic leg extended posteroobliquely over her abdominal dorsum; his metatibia was not flexed underneath. In preparation for copulation, the male twisted the distal half of his abdomen ventrally under the female. This maneuver considerably deformed the male's abdomen and placed his last abdominal tergum obliquely underneath the female's genital operculum (Fig. 2). The two plates of the male's last abdominal tergum separated medially and he extended the genital capsule anterodorsally, effectively placing the capsule upside down relative to its usual orientation in his body and pointing anteriorly; at rest the capsule and enclosed phallus point posteriorly. During copulation the male's parameres hooked onto the female's first gonapophyses.

DISCUSSION

Wiley (1922) observed *C. howardi* specimens copulating shortly after they had been taken from the field and placed in a common container. She noted that "the male takes a position to one side of the female,

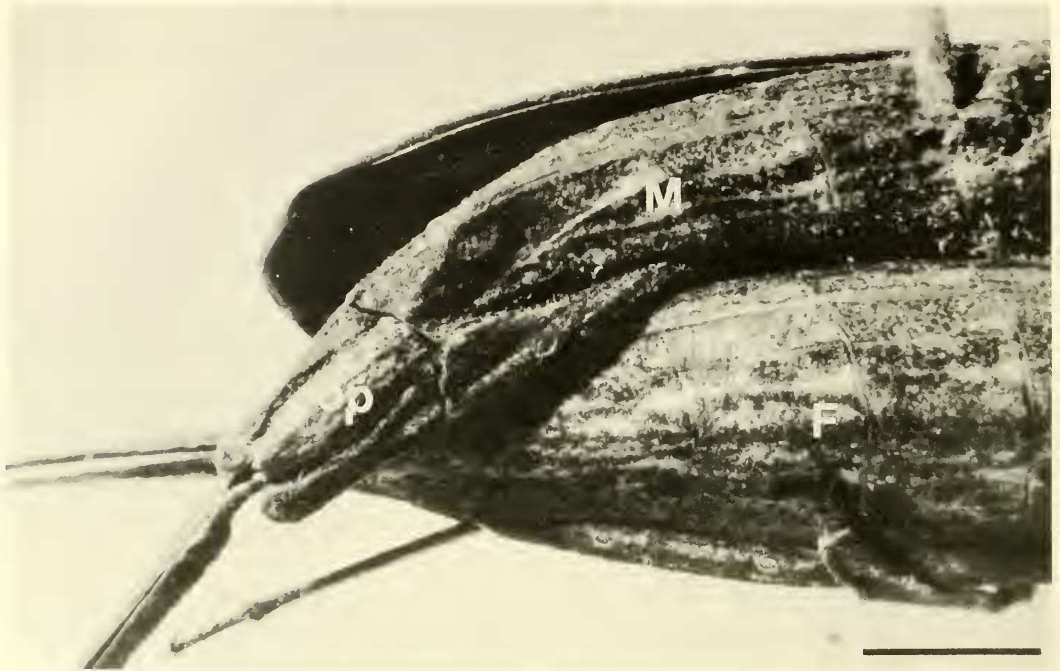


Fig. 2. Male and female *C. howardi* in copula, terminal abdominal segments, ventral view (bar scale = 2 mm). M = male; F = female; OP = male operculum.

and usually to the right. If to the right, he hooks his left anterior tarsus over her head; if to the left, the right fore tarsus is used" (p. 507). She observed that mating occurred almost daily from early spring through late summer (Wiley, 1924: 327) and that the duration of copulation often lasted several hours. Our results confirm Wiley's observations regarding both the male preference for grasping the female from her right and the often long duration of the copulations. In one respect, however, our results differ. In our laboratory cultures males always hooked their protibia, not just the protarsus, over the female's head. Interestingly, the use of the protibia/tarsus to grasp the female's head during copulation appears to be unique to the genus (see below). Thus, this trait can tentatively be considered diagnostic for *Curicta*.

Copulatory posture in two of the three other waterscorpion species studied resembles that observed for *Curicta howardi*. In *L. fabricii* (Mattei, 1965: 75, fig. 8C) and *N.*

cinerea (Poisson, 1924: plate 5, fig. 15; Larsén, 1938: 58, fig. 19), the male lies to one side and partially above the female as in *Curicta* but does not hook his protibia over the female's head. The protibia of the *L. fabricii* male grasps the female by the anterior half of the pronotum while the mesothoracic leg clasps her at the junction of her pronotum and abdomen. The protibia of the *N. cinerea* male grasps the female by the posterior part of the pronotum while the mesothoracic leg grasps the distal half of her abdomen. The metathoracic leg of both *L. fabricii* and *N. cinerea* extends postero-obliquely over the female abdominal dorsum as occurs in *C. howardi*. Mattei (1965) neither illustrated nor described the placement of the male abdomen of *L. fabricii* underneath the female other than to say on page 78, "le mâle glisse son extrémité abdominale au-dessous de l'abdomen de la femelle." However, his dorsal illustration of a copulating pair (p. 75, fig. 8C) shows the male respiratory siphons at about a 45° an-

gle to the female's siphons. This siphon configuration is similar to that illustrated and discussed for *N. cinerea* by Larsén (1938) suggesting that the same abdominal deformation occurs in *L. fabricii*. During copulation in *R. linearis*, the male does not deform the abdomen (see below) and the male's siphons diverge from the female's siphons at approximately 15°. As in *C. howardi*, the male *N. cinerea* deforms his abdomen to place the dorsum of his last abdominal segment under the female's operculum (Larsén 1938: p. 60, figs. 20–22) and the phallus is inserted upside down and backwards relative to its resting position.

The male of *R. linearis* assumes a somewhat different copulatory posture (Larsén 1938: p. 80, fig. 37). Instead of lying immediately adjacent to and partially on top of the female as occurs with *Curicta*, *Laccotrephes*, and *Nepa*, the male *Ranatra* angles the anterior part of his body away from the female while still hooking his profemur and tibia midway over her pronotum and his mesofemur and tibia over her abdomen just anterior to the inner angle of the hemelytral membranes. By angling away from the female, the male is able to place his last abdominal segment under her operculum without deforming his abdomen as in *Curicta*, *Laccotrephes*, and *Nepa*. During copulation, *Ranatra linearis* inserts an upside-down, backward phallus (p. 82, figs. 38–39) as do *Curicta*, *Nepa*, and presumably *Laccotrephes*.

The Nepidae are currently divided by Lansbury (1974) into two subfamilies (Nepinae, Ranatrinae) and five tribes (Nepini, Curictini, Goondnomdanepini, Austronepini, Ranatrini). According to this higher classification, *Curicta* (Curictini) is one of three "transitional" (pp. 222–223) genera, along with two Australian endemics, *Austronepa* (Austronepini) and *Goondnomdanepa* (Goondnomdanepini), between the genera of the tribe Nepini with their broad, dorsoventrally flattened bodies and the narrow, tubular-shaped genera of the Ranatri-

ni. Ten morphological characters are used in the Lansbury classification: four are weighted as subfamilial and six as tribal. *Curicta* is assigned to the subfamily Nepinae because it has the same four subfamilial characters as the genera of the Nepini. However, at the tribal level, *Curicta* is congruent with the Nepini for only 2 characters and with the Ranatrini for the remaining 4 characters. Similarly, *Austronepa* and *Goondnomdanepa* are assigned to the subfamily Ranatrinae because they possess the same subfamilial characters as the genera of the Ranatrini but at the tribal level, *Austronepa* and *Goondnomdanepa* are congruent with only four of six and one of six Ranatrini characters, respectively, while agreeing with the Nepini on the remaining characters. Hence, these three genera are each accorded their own tribe and are understood as "transitional" because they each possess a mix of Nepini and Ranatrini character states.

Laccotrephes and *Nepa* belong to the Nepinae-Nepini and *Ranatra* belongs to the Ranatrinae-Ranatrini. The deformation of the male abdomen during copulation found in *Curicta*, *Laccotrephes*, and *Nepa* further aligns *Curicta* with the Nepinae. Unfortunately, nothing is currently known about the copulatory postures of the other two transitional waterscorpion genera, *Austronepa* and *Goondnomdanepa*. The Nepinae, including *Curicta*, all have visible abdominal parasterna, whereas the Ranatrinae, including the transitional Australian genera, have the parasterna infolded (Menke and Stange 1964, Lansbury 1974). Could it be that this parasternal infolding structurally prevents the male Ranatrinae abdomen from twisting under the female's abdomen during copulation? If it is found that males of all the Ranatrinae genera do not deform their abdomens during copulation, then this aspect of waterscorpion copulatory posture will constitute an additional character in support of Lansbury's subfamilial classification. If, however, males of *Austronepa* and/or *Goondnomdanepa* are observed to twist

their abdomens under the female in the Nepini/Curictini manner, then copulatory posture will constitute a tribal character in the Lansbury classification thus further contributing to the mixing of Nepini and Ranatrini characters in the three transitional genera.

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